P. S. Prakasa RAO* & K. Raja Rajeswari DEVI*: **Embryo development in *Euphorbia marginata* Pursh**

P. S. プラサカ ラオ・K. R. R. デヴィ : *Euphorbia marginata* の胚発生

Euphorbiaceae, the sixth largest family of angiosperms (Good, 1953), is predominantly tropical comprising 280 genera and 7300 species (Lawrence, 1965). It displays an extreme range of variation in habit, habitat and morpho-embryological features. Although the family is well known for the presence of eight different types of embryo sacs (Maheshwari, 1942; Banerji, 1951; Rao, 1970) and five major types of embryo development (Rao, 1970), the available literature indicates that our knowledge concerning the development of both the gametophyte and embryo is confined only to a few species. Further, within the genus *Euphorbia*, while most of its species manifest *Euphorbia*-variation of Onagrad type of embryo development, *Euphorbia corrogloides* (Sathianathan, 1974) exhibits the *Lotus*-variation. It has been recorded, however, in *Euphorbia peltata* (Mukherjee, 1965) and *Euphorbia preslii* (Weniger, 1917) that the embryo development follows the Chenopodiad and Piperad type respectively. In view of this diversity in embryogeny within a few species of *Euphorbia* and since details of development are known for scant species of this genus, it has been considered worthwhile to extend the study to some other species of this genus, as also doubtful cases with a view to obtain a correct picture of embryo development in the genus as a whole.

Material and methods The material, which was received from Pennsylvania, U.S.A., was dehydrated and embedded in paraffin as per the customary methods. Sections cut at a thickness of 8 to 10 microns were stained in safranin and fast green.

Observations and conclusion The zygote undergoes a brief period of rest and divides after 22 endosperm nuclei are formed (Fig. 1). The fertilized egg becomes vacuolated, gorged with starch grains (Fig. 2) and divides transversely to produce the terminal cell *ca* and the basal cell *cb*

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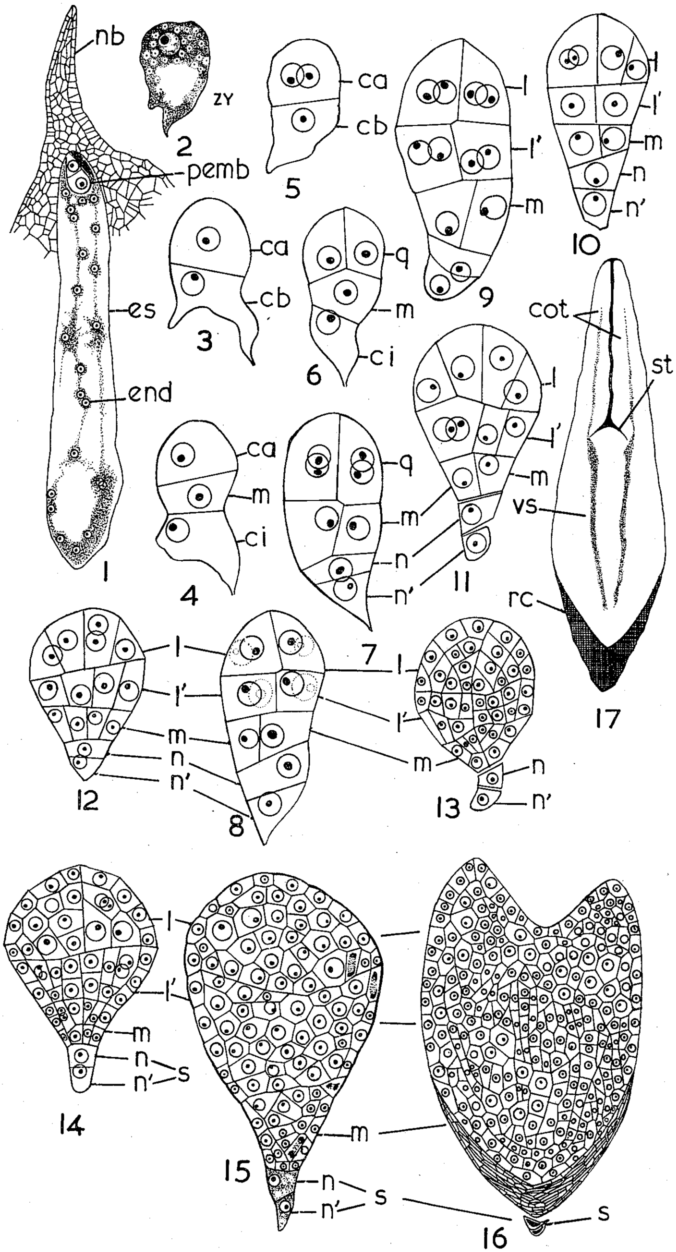
(Figs. 1, 3). The 2-celled proembryo displays further division in *cb* engendering two superposed cells, *m* and *ci* either before or after *ca* has undergone longitudinal division resulting in the formation of two juxtaposed cells (Figs. 4, 5, 6). This represents the end of second cell generation, and the proembryo is T-shaped comprising four cells displayed in three tiers (Fig. 6).

The derivatives of the terminal cell *ca* divide by another vertical wall at right angles to the previous plane and initiate a quadrant (Fig. 7). In the meantime, *m* also divides by a vertical wall and *ci* transversely procreating *n* and *n′* (Figs. 7, 8). This completes the third cell generation and the proembryo embraces 8 cells disposed in four tiers.

At the later cell generation, each cell of the quadrant divides transversely forming an octant disposed in two tiers *l* and *l′* of four cells each (Fig. 9). At about this time the embryo manifests five tiers, that is, the two terminal tiers *l* and *l′* of four cells each, the next one *m* with two juxtaposed cells and the lower two tiers *n* and *n′* of one cell each (Fig. 9). In each cell of the terminal tier *l* oblique wall is laid down to form an inner and outer cell (Fig. 10). The former cells on further division in transverse and longitudinal planes over and again differentiate the plumule, while the latter cells constitute the initials for the cotyledons. Following these divisions in the tier *l*, the cells of the tier *l′* divide periclinally to demarcate the dermatogen which also develops in the tiers *l* and *m* (Figs. 11, 12). The divisions in *l′* are initially sequential and longitudinal and followed by a series of transverse and longitudinal divisions resulting in the differentiation of hypocotyl and radicle (Figs. 13, 14, 15). Subsequent divisions in *l′* demarcate the plerome and periblem.

As mentioned earlier, the basal cell *cb* of the 2-celled proembryo divides longitudinally to form *m* and *ci*. The tier *m*, which is 1-celled at the quadrant stage of the proembryo (Fig. 6), divides by a vertical wall and forms two juxtaposed cells which again divide vertically resulting in a group of four cells (Fig. 12). Further divisions in these cells complete the formation of dermatogen of the root tip, root cortex and the central part of the roop cap. The cells of the dermatogen on periclinal divisions and anticlinal divisions establish the lateral part of the root cap (Fig. 16).

The *ci* which is a derivative of *cb* divides by a transverse wall to

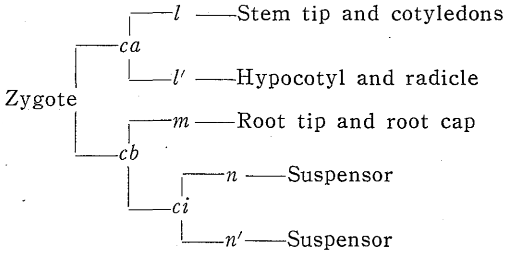


Figs. 1-17. 1. Nucellar beak, embryo sac with 2-celled proembryo and 22 free endosperm nuclei 2-16. Stages in the development of embryo. nb: nucellar beak. zy: zygote. cot: cotyledon. end: endosperm. es: embryo sac. pemb: proembryo. rc: root cap. st: stem tip. vs: vascular supply. 1 ×75. 2-12 ×500. 13-16 ×300. 17 ×20.

engender two superposed cells n and n' and these elements finally constitute a 2-celled weak suspensor which subsequently becomes dwindled in a mature embryo (Figs. 8-16).

The mature embryo is dicotyledonous, straight with well developed shoot apex, root, vascular supply and with no traces of suspensor (Fig. 17).

The origin of the diverse parts of the mature embryo from the varied tiers of the proembryo and their embryonic formulae for the successive four cell generations are presented below:



I —First cell generation: The proembryo is 2-celled

$ca=\text{pco}+\text{pvt}+\text{phy}+\text{icc}$

$cb=\text{iec}+\text{co}+\text{s}$

II —Second cell generation: The proembryo has four cells disposed in three tiers

$ca=\text{pco}+\text{pvt}+\text{phy}+\text{icc}$

$m=\text{iec}+\text{co}$

$ci=\text{s}$

III —Third cell generation: The proembryo has eight cells arranged in four tiers

$q=\text{pco}+\text{pvt}+\text{phy}+\text{icc}$

$m=\text{iec}+\text{co}$

$n=\text{s}$

$n'=\text{s}$

IV—Fourth cell generation: The proembryo has 12 cells placed in five tiers

$l=\text{pco}+\text{pvt}$

$l'=\text{phy}+\text{icc}$

$m=\text{iec}+\text{co}$

$n=\text{s}$

$n'=\text{s}$

It is obvious from the foregoing account that the embryogeny in *Euphorbia marginata* is identical in all essential features to that of *Euphorbia procera* (Modilewski, 1909), *E. splendens* (Weniger, 1917), *E. esula* (Souèges, 1924), *E. exigua* (Souèges, 1925), *E. hirta* (Kajale, 1954), *E. hypericifolia* (Mukherjee, 1957), *E. microphylla* and *E. dracunculoides* (Mukherjee, 1961 a) and *E. vermiculata* (Prakasa Rao and Raja Rajeswari Devi, 1974) with the difference that the eight cells are disposed in four tiers at the third cell generation of the proembryo and thereby broadly conforming to the *Myosurus* variation of the Onagrad type of Johansen (1950) or archetype of *Myosurus minimus* of Megarchetype IV in the First embryonic group of Souèges' (see Crété, 1963).

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トウダイグサ科は約280属，7300種を含む熱帯中心として分布する大形の科であり，外形，生活型上の変化も多い。この科のうちには胚嚢の型が8個，胚発生の型が5個あることが知られている。*Euphorbia* の中，大部分の種は知られている限り Onagrad 型の変型を示す。しかし，*E. peltata*, *E. Preslii* はおのおの Chenopodiad 型，Piperad 型を示すことが報告されている。今回は，*E. marginata* Pursh について詳細に研究し，これが明かに Onagrad 型の別の変型を示すことが分った。

□**The Kew record of taxonomic literature relating to vascular plants** for 1971. pp. 394 Her Majesty's Stationary Office, Atlantic House, Holborn Viaduct, London, EC1P 1BN £14 net. 略称キューレコード1971はこの9月に出版された。従来5年毎にまとめて種以上の新名は Index Kewensis として出版されて来ているが，その範囲を越えてもっと深くもっと広く，そしてもっと早く報道しようというねらいから毎年発行されることになった。画期的のものといえよう。この本はその精神に従って1971年中に出版され，キュー植物園，大英博物館及びオクスフォードの Commonwealth Forestry Institute に送られた文献からチェックされたシダ類，裸子被子植物をカバーする全分類にわたるもので，なお命名規則，染色体，ケモタクソノミー，解剖，形態，花粉，胚，発生等までを含めて，文献を網羅することにつとめたという。そして今回は6457個の文献がリストされているから大変な努力であった。然し何といっても重点は各科別に整頓された部分である。文献名，出典はもちろんだが，内容の重点や図の有無など，それに使用国語の種類まで添記されており，新群は品種に到るまで列記されているし，夫々には産地が世界を7地区にわけて番号表記もされているなどまことに親切である。このようなものがこれから毎年出されるとなれば，便宜この上もないことで，一層学問の交流に大きく貢献することであろう。英国人の切実な努力に敬意を表するものである。日本人の姓名は読みにくいとみえて，Tatsuyuki, O. など姓名が逆になったものがあるし，学名にも誤りが見られるが，これは直してほしい。 (前川文夫)